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### FIG. 10

ENTRY

DETERMINE MASS POINT POSITIONS AND BODY POSTURE OF 1ST DISPLACEMENT DIMENSION CORRECTING MODEL ON THE BASIS OF INSTANTANEOUS VALUES OF SIMPLIFIED MODEL GAIT AT CURRENT TIME 1.

**S202** 

**S200** 

DETERMINE INITIAL CANDIDATES (Pb2\_s,  $\theta$  b2\_s) of displacement dimension corrected body Position/Posture according to the following expressions on the basis of displacement dimension corrected body Position Pb2\_p, desired body Position Pb\_p, displacement dimension corrected body Posture  $\theta$  b2\_p, and desired body Position Pb and desired body Posture  $\theta$  b\_p at last time t—  $\Delta t$ , and desired body Position Pb and Desired Body Posture  $\theta$  b at current time t.

 $Pb2_s = Pb + (Pb2_p - Pb_p)$  $\theta b2_s = \theta b + (\theta b2_p - \theta b p)$ 

**DIMENSION CORRECTING MODEL.** 

DETERMINE MASS POINT POSITIONS OF 2ND DISPLACEMENT DIMENSION CORRECTING MODEL ON THE BASIS OF CURRENT CANDIDATES (Pb2\_s,  $\Theta$  b2\_s) and desired positions/postures of both feet at current time t.

S208

**S206** 

DETERMINE OVERALL CENTER OF GRAVITY ERROR GC\_err AND ANGULAR MOMENTUM PRODUCT ERROR L\_err BETWEEN 1ST DISPLACEMENT DIMENSION CORRECTING MODEL AND 2ND DISPLACEMENT

**S210** yes

LEAVE REPETITION LOOP.

S212

S204 ARE GC e

 $\infty$ 

ARE Gc\_err AND L\_err WITHIN PERMISSIBLE RANGES?

**S214** 

DETERMINE A PLURALITY OF CANDIDATES (Pb2\_s+ $\triangle$  Pbx,  $\theta$  b2\_s), (Pb2\_s+ $\triangle$  Pbz,  $\theta$  b2\_s) and (Pb2\_s,  $\theta$  b2\_s +  $\triangle$   $\theta$  b) near (Pb2\_s,  $\theta$  b2\_s), then use them as displacement dimension corrected body position/posture candidates to determine overall center of gravity error and angular momentum product error as described above.

BASED ON OVERALL CENTER OF GRAVITY ERROR AND ANGULAR MOMENTUM PRODUCT ERROR ASSOCIATED WITH (Pb2\_s,  $\theta$  b2\_s) and candidates in the vicinity thereof, DETERMINE NEW DISPLACEMENT DIMENSION CORRECTED BODY POSITION/POSTURE CANDIDATES (Pb2\_s,  $\theta$  b2\_s) so as to approximate the errors to zero.

**S216** 

SUBSTITUTE CURRENT (Pb2\_s,  $\Theta$  b2\_s) INTO DISPLACEMENT DIMENSION CORRECTED BODY POSITION/POSTURE (Pb2,  $\Theta$  b2) at current time t.

**S218** 

RETURN

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# **FIG.23**

**ENTRY** 

**S400** 

DETERMINE MASS POINT POSITIONS AND POSTURES OF BODY AND ARMS OF 1ST DISPLACEMENT DIMENSION CORRECTING MODEL ON THE BASIS OF INSTANTANEOUS VALUES OF SIMPLIFIED MODEL GAIT AT CURRENT TIME 1.

**S402** 

DETERMINE INITIAL CANDIDATES (Pb2\_s,  $\Theta$  b2\_s) OF DISPLACEMENT DIMENSION CORRECTED BODY POSITION/POSTURE ACCORDING TO THE FOLLOWING EXPRESSIONS ON THE BASIS OF DISPLACEMENT DIMENSION CORRECTED BODY POSITION Pb2\_p, DESIRED BODY POSITION Pb\_p, DISPLACEMENT DIMENSION CORRECTED BODY POSTURE  $\Theta$  b2\_p, and desired body posture  $\Theta$  b\_p at last time 1—  $\triangle$  1, and desired body position Pb and desired body posture  $\Theta$  b at current time 1.

 $Pb2_s = Pb + (Pb2_p - Pb_p)$   $\theta b2_s = \theta b + (\theta b2_p - \theta b_p)$ 

**S406** 

DETERMINE MASS POINT POSITIONS AND POSTURES OF ARMS OF 2ND DISPLACEMENT DIMENSION CORRECTING MODEL ON THE BASIS OF CURRENT CANDIDATES (Pb2\_s,  $\theta$  b2\_s) AND DESIRED POSITIONS/POSTURES OF BOTH FEET AND DESIRED ARM POSTURES AT CURRENT TIME t.

DETERMINE OVERALL CENTER OF GRAVITY ERROR GC\_err AND ANGULAR MOMENTUM PRODUCT ERROR L\_err BETWEEN 1ST DISPLACEMENT DIMENSION CORRECTING MODEL AND 2ND DISPLACEMENT DIMENSION CORRECTING MODEL.

S408

ARE GC err AND L err WITHIN PERMISSIBLE RANGES?

S410 yes

LEAVE REPETITION LOOP.

S414

**S412** 

 $\infty$ 

**S404** 

DETERMINE A PLURALITY OF CANDIDATES (Pb2\_s+ $\triangle$  Pbx,  $\theta$  b2\_s), (Pb2\_s+ $\triangle$  Pbz,  $\theta$  b2\_s) and (Pb2\_s,  $\theta$  b2\_s +  $\triangle$   $\theta$ b) near (Pb2\_s,  $\theta$  b2\_s), then use them as displacement dimension corrected body position/posture candidates to determine overall center of gravity error and angular momentum product error as described above.

BASED ON OVERALL CENTER OF GRAVITY ERROR AND ANGULAR MOMENTUM PRODUCT ERROR ASSOCIATED WITH (Pb2\_s,  $\theta$  b2\_s) and candidates in the vicinity thereof, DETERMINE NEW DISPLACEMENT DIMENSION CORRECTED BODY POSITION/POSTURE CANDIDATES (Pb2\_s,  $\theta$  b2\_s) so as to approximate the errors to zero.

**S416** 

SUBSTITUTE CURRENT (Pb2\_s,  $\theta$  b2\_s) Into displacement dimension corrected body Position/Posture (Pb2,  $\theta$  b2) at current time 1.

S418

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### **FIG.10**

**ENTRY** 

DETERMINE MASS POINT POSITIONS AND BODY POSTURE OF 1ST DISPLACEMENT DIMENSION CORRECTING MODEL ON THE BASIS OF INSTANTANEOUS VALUES OF SIMPLIFIED MODEL GAIT AT CURRENT TIME 1.

**S200** 

S202

DETERMINE INITIAL CANDIDATES (Pb2\_s,  $\theta$  b2\_s) of displacement dimension corrected body Position/Posture according to the following expressions on the basis of displacement dimension corrected body Position Pb2\_p, desired body Position Pb\_p, displacement dimension corrected body Posture  $\theta$  b\_p at last time 1—  $\Delta$  1, and desired body Position Pb and Desired Body Posture  $\theta$  b at current time 1.

 $Pb2_s = Pb + (Pb2_p - Pb_p)$  $\theta b2_s = \theta b + (\theta b2_p - \theta b_p)$ 

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DETERMINE MASS POINT POSITIONS OF 2ND DISPLACEMENT DIMENSION CORRECTING MODEL ON THE BASIS OF CURRENT CANDIDATES (Pb2\_s,  $\theta$  b2\_s) and desired positions/postures of both feet at current time t.

S208

**S206** 

DETERMINE OVERALL CENTER-OF-GRAVITY ERROR GC\_err AND ANGULAR MOMENTUM PRODUCT ERROR L\_err between 1st displacement dimension correcting model and 2nd displacement dimension correcting model.

S210 yes

LEAVE REPETITION LOOP.

S212

ARE Gc\_err AND L\_err WITHIN PERMISSIBLE RANGES?

**S214** 

DETERMINE A PLURALITY OF CANDIDATES (Pb2\_s+ $\triangle$  Pbx,  $\theta$  b2\_s), (Pb2\_s+ $\triangle$  Pbz,  $\theta$  b2\_s) and (Pb2\_s,  $\theta$  b2\_s +  $\triangle$   $\theta$  b) NEAR (Pb2\_s,  $\theta$  b2\_s), THEN USE THEM AS DISPLACEMENT DIMENSION CORRECTED BODY POSITION/POSTURE CANDIDATES TO DETERMINE OVERALL CENTER-OF-GRAVITY ERROR AND ANGULAR MOMENTUM PRODUCT ERROR AS DESCRIBED ABOVE.

BASED ON OVERALL CENTER-OF-GRAVITY ERROR AND ANGULAR MOMENTUM PRODUCT ERROR ASSOCIATED WITH (Pb2\_s,  $\theta$  b2\_s) and candidates in the vicinity thereof, DETERMINE NEW DISPLACEMENT DIMENSION CORRECTED BODY POSITION/POSTURE CANDIDATES (Pb2\_s,  $\theta$  b2\_s) so as to approximate the errors to zero.

S216

SUBSTITUTE CURRENT (Pb2\_s,  $\Theta$  b2\_s) INTO DISPLACEMENT DIMENSION CORRECTED BODY POSITION/POSTURE (Pb2,  $\Theta$  b2) at current time 1.

**]** S218

RETURN

**S204** 

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19/20

## **FIG.23**

**ENTRY** 

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**S400** 

DETERMINE MASS POINT POSITIONS AND POSTURES OF BODY AND ARMS OF 1ST DISPLACEMENT DIMENSION CORRECTING MODEL ON THE BASIS OF INSTANTANEOUS VALUES OF SIMPLIFIED MODEL GAIT AT CURRENT TIME 1.

**S402** 

DETERMINE INITIAL CANDIDATES (Pb2\_s,  $\theta$  b2\_s) OF DISPLACEMENT DIMENSION CORRECTED BODY POSITION/POSTURE ACCORDING TO THE FOLLOWING EXPRESSIONS ON THE BASIS OF DISPLACEMENT DIMENSION CORRECTED BODY POSITION Pb2\_p, DESIRED BODY POSITION Pb\_p, DISPLACEMENT DIMENSION CORRECTED BODY POSTURE  $\theta$  2b\_p, and desired body posture  $\theta$  b\_p at last time 1—  $\Delta$  1, and desired body position Pb AND DESIRED BODY POSTURE heta b at current time t

 $Pb2_s = Pb + (Pb2 p - Pb p)$ 

 $\theta$  b2 s=  $\theta$  b + ( $\theta$  b2\_p -  $\theta$  b\_p)

**S406** 

DETERMINE MASS POINT POSITIONS AND POSTURES OF ARMS OF 2ND DISPLACEMENT DIMENSION CORRECTING MODEL ON THE BASIS OF CURRENT CANDIDATES (Pb2\_s,  $\theta$  b2\_s) and desired POSITIONS/POSTURES OF BOTH FEET AND DESIRED ARM POSTURES AT CURRENT TIME t.

DETERMINE OVERALL CENTER-OF-GRAVITY ERROR GC err AND ANGULAR MOMENTUM PRODUCT **S408** ERROR L\_err BETWEEN 1ST DISPLACEMENT DIMENSION CORRECTING MODEL AND 2ND DISPLACEMENT DIMENSION CORRECTING MODEL.

\$410 yes

**S412** LEAVE REPETITION LOOP.

**S404** 

 $\infty$ 

**S414** 

S416

ARE Gc\_err AND L err WITHIN PERMISSIBLE RANGES?

DETERMINE A PLURALITY OF CANDIDATES (Pb2\_s+  $\triangle$  Pbx,  $\theta$  b2\_s), (Pb2\_s+  $\triangle$  Pbz,  $\theta$  b2\_s) AND (Pb2\_s,  $\theta$  b2\_s +  $\Delta$   $\theta$  b) NEAR (Pb2\_s,  $\theta$  b2\_s), Then use them as displacement dimension CORRECTED BODY POSITION/POSTURE CANDIDATES TO DETERMINE OVERALL CENTER-OF-GRAVITY ERROR AND ANGULAR MOMENTUM PRODUCT ERROR AS DESCRIBED ABOVE.

BASED ON OVERALL CENTER-OF-GRAVITY ERROR AND ANGULAR MOMENTUM PRODUCT ERROR ASSOCIATED WITH (Pb2\_s,  $\theta$  b2\_s) and candidates in the vicinity thereof, DETERMINE NEW DISPLACEMENT DIMENSION CORRECTED BODY POSITION/POSTURE CANDIDATES (Pb2\_s,  $\theta$  b2 s) SO AS TO APPROXIMATE THE ERRORS TO ZERO.

SUBSTITUTE CURRENT (Pb2\_s,  $\theta$  b2\_s) INTO DISPLACEMENT DIMENSION CORRECTED BODY POSITION/POSTURE (Pb2,  $\Theta$  b2) AT CURRENT TIME t.

**S418** 

RETURN